



Radar & Antenna Specifications Formulas

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List of 24 Radar & Antenna Specifications Formulas

Radar & Antenna Specifications 🗗

1) Antenna Aperture Efficiency

 $= \frac{17.5875 \text{m}^2}{25.125 \text{m}^2}$

2) Antenna Area

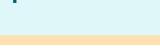
 $oldsymbol{A}_{
m a} = rac{{
m A}_{
m eff}}{\eta_{
m a}}$

 $= 25.125 \mathrm{m}^{_{2}} = \frac{17.5875 \mathrm{m}^{_{2}}}{0.7}$

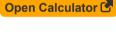
3) Cumulative Probability of Detection

 $\left[\mathbf{p}_{\mathrm{c}}=1-\left(1-\mathrm{p}_{\mathrm{detect}}
ight)^{\mathrm{n}}
ight]$

 $\boxed{ \textbf{ex} \left[0.4375 = 1 - \left(1 - 0.25 \right)^2 \right] }$



Open Calculator



Open Calculator





4) Doppler Angular Frequency

fx $\omega_{
m d} = 2 \cdot \pi \cdot {
m f}_{
m d}$

Open Calculator

ex $64.71681 \text{rad/s} = 2 \cdot \pi \cdot 10.3 \text{Hz}$

5) Doppler Frequency 6

fx $f_{
m d}=rac{\omega_{
m d}}{2\cdot\pi}$

Open Calculator 2

 $ext{ex} 10.30003 ext{Hz} = rac{64.717 ext{rad/s}}{2 \cdot \pi}$

6) Effective Area of Receiving Antenna

fx $A_{
m eff}=A_{
m a}\cdot\eta_{
m a}$

Open Calculator 2

Open Calculator 2

ex 17.5875m² = 25.125m² · 0.7

7) Maximum Gain of Antenna

fx $G_{max} = rac{
ho_{max}}{}$

$$= 1.5 dB = \frac{15 kW/m^3}{10 kW/m^3}$$



8) Maximum Power Density Radiated by Antenna

 $\int \mathbf{x} \left[
ho_{\mathrm{max}} =
ho \cdot G_{\mathrm{max}} \right]$

Open Calculator 🗗

 $\textbf{ex} \left[15 \text{kW/m}^{\scriptscriptstyle 3} = 10 \text{kW/m}^{\scriptscriptstyle 3} \cdot 1.5 \text{dB} \right]$

9) Maximum Range of Radar 🖸

 $R_{t} = \left(rac{P_{trns} \cdot G_{trns} \cdot \sigma \cdot A_{eff}}{16 \cdot \pi^{2} \cdot S_{min}}
ight)^{0}$

Open Calculator 🗗

10) Maximum Unambiguous Range

 $m R_{un} = rac{[c] \cdot T_{pulse}}{2}$

Open Calculator

= 8.789915km = $\frac{[c] \cdot 58.64 \mu s}{2}$

11) Measured Runtime

 $ag{T_{
m run}} = 2 \cdot rac{
m R_t}{
m [c]}$

Open Calculator

 $= 2 \cdot \frac{289.62 \mathrm{m}}{[\mathrm{c}]}$





12) Minimum Detectable Signal

Open Calculator 2

Open Calculator

Open Calculator 2

Open Calculator 2

 $S_{\min} = rac{P_{trns} \cdot G_{trns} \cdot \sigma \cdot A_{eff}}{16 \cdot \pi^2 \cdot R_t^4}$

 $oxed{ex} 0.026 \mathrm{W} = rac{100 \mathrm{kW} \cdot 657 \cdot 25 \mathrm{m}^2 \cdot 17.5875 \mathrm{m}^2}{16 \cdot \pi^2 \cdot \left(289.62 \mathrm{m}
ight)^4}$

13) N Scans

 $n = rac{\log 10(1-\mathrm{p_c})}{\log 10(1-\mathrm{p_{detect}})}$

 $2 = \frac{\log 10(1 - 0.4375)}{\log 10(1 - 0.25)}$

14) Power Density Radiated by Lossless Antenna 🗗

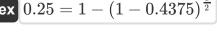
 $\left|
ho
ight|
ho=rac{
ho_{
m max}}{G_{
m max}}$

= $10 \text{kW/m}^3 = \frac{15 \text{kW/m}^3}{1.5 \text{dB}}$

15) Probability of Detection

 $p_{
m detect} = 1 - (1-p_{
m c})^{rac{1}{
m n}}$

 $oxed{ex} 0.25 = 1 - (1 - 0.4375)^{rac{1}{2}}$









16) Pulse Repetition Frequency

 $\mathbf{f}_{\mathrm{rep}} = rac{[\mathrm{c}]}{2 \cdot \mathrm{R}_{\mathrm{up}}}$

Open Calculator 🗗

= $17053.04 \mathrm{Hz} = rac{[\mathrm{c}]}{2 \cdot 8.79 \mathrm{km}}$

17) Pulse Repetition Time

 $ag{T_{
m pulse}} = rac{2 \cdot {
m R_{un}}}{[
m c]}$

Open Calculator

= $58.64057 \mu s = rac{2 \cdot 8.79 \mathrm{km}}{[c]}$

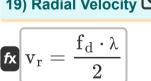
18) Radar Antenna Height

 $\mathbf{H}_{\mathrm{a}} = rac{\Delta \mathrm{R} \cdot \mathrm{R}_{\mathrm{o}}}{2 \cdot \mathrm{H}_{\mathrm{t}}}$

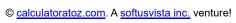
Open Calculator 🖸

= $450 \mathrm{m} = \frac{9 \mathrm{m} \cdot 40000 \mathrm{m}}{2 \cdot 400 \mathrm{m}}$

19) Radial Velocity









Open Calculator

20) Range of Target

 $m R_t = rac{[c] \cdot T_{run}}{2}$

Open Calculator 🗗

 $= 289.5995 m = \frac{[c] \cdot 1.932 \mu s}{2}$

21) Target Height

 $\mathbf{H}_{\mathrm{t}} = rac{\Delta \mathbf{R} \cdot \mathbf{R}_{\mathrm{o}}}{2 \cdot \mathbf{H}_{\mathrm{a}}}$

Open Calculator 🗗

22) Target Velocity

 $v_{
m t} = rac{\Delta f_{
m d} \cdot \lambda}{2}$

Open Calculator

 $= \frac{20 \mathrm{Hz} \cdot 0.58 \mathrm{m}}{2}$

23) Transmitted Frequency

 $\mathbf{f_{trns}} = \mathbf{f_d} \cdot rac{[\mathrm{c}]}{2 \cdot \mathrm{v_{ ext{-}}}}$

Open Calculator

 $\boxed{5.2\text{E} \, ^{\hat{}} \text{8Hz} = 10.3\text{Hz} \cdot \frac{[\text{c}]}{2 \cdot 2.987 \text{m/s}}}$



24) Transmitted Gain



Open Calculator 🗗

$$\mathbf{ex} = 656.9888 = rac{4 \cdot \pi \cdot 17.5875 \mathrm{m}^2}{\left(0.58 \mathrm{m}
ight)^2}$$



Variables Used

- A_a Antenna Area (Square Meter)
- Apff Effective Area of Receiving Antenna (Square Meter)
- **f**_d Doppler Frequency (*Hertz*)
- **f**rep Pulse Repetition Frequency (Hertz)
- **f**_{trns} Transmitted Frequency (Hertz)
- G_{max} Maximum Gain of Antenna (Decibel)
- G_{trns} Transmitted Gain
- Ha Antenna Height (Meter)
- H_t Target Height (Meter)
- n N Scans
- p_c Cumulative Probability of Detection
- p_{detect} Detection Probability of Radar
- P_{trns} Transmitted Power (Kilowatt)
- Ro Range (Meter)
- Rt Target Range (Meter)
- R_{un} Maximum Unambiguous Range (Kilometer)
- S_{min} Minimum Detectable Signal (Watt)
- T_{pulse} Pulse Repetition Time (Microsecond)
- Trun Measured Runtime (Microsecond)
- V_r Radial Velocity (Meter per Second)





- V_t Target Velocity (Meter per Second)
- Δf_d Doppler Frequency Shift (Hertz)
- ΔR Range Resolution (Meter)
- η_a Antenna Aperture Efficiency
- λ Wavelength (Meter)
- p Lossless Isotropic Power Density (Kilowatt Per Cubic Meter)
- Pmax Maximum Radiated Power Density (Kilowatt Per Cubic Meter)
- σ Cross Section Area of Radar (Square Meter)
- ω_d Doppler Angular Frequency (Radian per Second)





Constants, Functions, Measurements used

- Constant: pi, 3.14159265358979323846264338327950288
 Archimedes' constant
- Constant: [c], 299792458.0 Meter/Second Light speed in vacuum
- Function: log10, log10(Number)
 Common logarithm function (base 10)
- Measurement: Length in Meter (m), Kilometer (km)
 Length Unit Conversion
- Measurement: Time in Microsecond (μs)
 Time Unit Conversion
- Measurement: Area in Square Meter (m²)
 Area Unit Conversion
- Measurement: Speed in Meter per Second (m/s)
 Speed Unit Conversion
- Measurement: Power in Kilowatt (kW), Watt (W)
 Power Unit Conversion
- Measurement: Frequency in Hertz (Hz)
 Frequency Unit Conversion
- Measurement: Sound in Decibel (dB)
 Sound Unit Conversion
- Measurement: Power Density in Kilowatt Per Cubic Meter (kW/m³)

 Power Density Unit Conversion
- Measurement: Angular Frequency in Radian per Second (rad/s)
 Angular Frequency Unit Conversion





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- Radar & Antenna Specifications
 Special Purpose Radars Formulas
 - Formulas
- Radar Antennas Reception Formulas [7]

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